FARMING SYSTEMS RESEARCH AND DEVELOPMENT IN THAILAND

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PRINCIPLES AND STEPS OF THE METHOD OF DIAGNOSIS ON AGRARIAN SYSTEMS : A CASE STUDY FROM SATHING PHRA AREA SOUTHERN THAILAND

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ABSTRACT

In many cases, the failure of agricultural development projects has been attributed to a lack of understanding of farmers varied circumstances, and of the practices and strategies they adopt to achieve their goals. In order to overcome this problem, the need for a preliminary phase of a directed diagnosis prior to any research and development actions, is now widely recognized. Its general objectives are to understand the internal coherence and to classify the existing farming systems according to their socio - economic objectives and the kinds of problems faced in reaching them.

This paper presents a set of tools articulated into a global, systemic and historical approach based on the coherence concept of agrarian system. After a definition of its main interrelated variables, each step of the methodology of diagnosis proposed here is described and illustrated by examples from the rice - growing area of Sathing Phra.

The first stage involves an agro - ecological zonation and analysis of the recent technical and socio - economic transformations of the regional

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context in order to understand the organization of the landscape and its evolution. This is followed by the selection of different types of villages and a limited number of agricultural production systems for an in - depth analysis of their functioning pattern. The subsequent building of a functional typology of the local farming systems based on the differentiation of their socio-economic objectives and the constraints to achieving them constitutes a key stage. Finally the role and evolutionary trend of each type of farming systems identified are evaluated in a synthesis at the regional agrarian system level. Taking into account the national agricultural policy and the international environment, priorities can be given to the various problems identified at the farm level to feed the second phase of on - farm design of appropriate technologies or socio - economic organizations for each type of agricultural production system concerned.

INTRODUCTION

Too often, the failure of agricultural development projects is attributed to a misappreciation of the real conditions of production. In most of these cases, farmers'objectives, as well as the strategies they adopt to achieve them are simply ignored. In fact, they are of paramount importance if one is trying to understand the rationale of farmers'existing practices. Thus, the need for an holistic preliminary diagnosis, prior to agricultural applied research or development actions, is now widely recognized (Dufumier, 1987).

The method of diagnosis on agrarian systems[1] which is proposed here focuses on the study of the functioning and evolution of the different types of agricultural production systems (APS)[2] in a small, quite homogeneous, regional area. This approach departs from the usual following linear diagram :

Researcher ——————→ Extensionist ——————→ Farmer

In this approach, "technological packages" are produced but are very often inappropriate to farmers' circumstances. This is because, as they are

1. AGRARIAN SYSTEM = an historically constituted mode of exploitation of the environment, durably adapted to the bioclimatic conditions of a given area and corresponding to the local social conditions and needs at that moment (MAZOYER, 1985).

2. AGRICULTURAL PRODUCTION SYSTEM = a whole structured set of plants, animals and other productions or activities selected by a farmer for his production unit in order to realize his objectives.

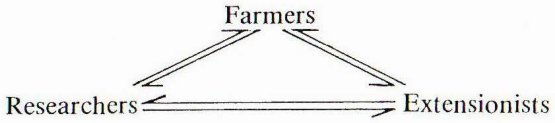
designed mostly through on - experimental station research work, their domains of extrapolation have not been delimited. Farmers and on - station researchers are working in fundamentally different situations (Figure 1).

The real problem is : how to translate a scientific knowledge from the station into an action rule for farmers?

	RESEARCH STATION	FARMERS APS
OBJECTIVE =	To maximize the physical production of one species per land unit.	To optimize the functioning of a more or less complex APS.
BIO-PHYSICAL ENVIRONMENT =	Predominance of homogeneous plots. Total control of all the variables is possible.	Heterogeneity is dominant at the farm and plot levels. The control of many variables is limited.
FACTORS OF PRODUCTION =	Not limiting and well controlled.	At least one of them is limiting (land, labor, equipment and capital).
RISK FACTOR =	Consequences of a complete failure are of limited importance.	Has to be limited in order to guarantee the survival of the APS.

Figure 1. Comparison between on - station and on - farm conditions for the production of agricultural technical references.

In such situations, the reinforcement of the agricultural extension network and the sophistication of its methods of work are not very useful in face of what is commonly interpreted as a "resistance" from the farmers to adopt the proposed new technologies. But more and more, the necessity for the agricultural researcher to adapt his technical references to the real conditions of production faced by the farmers becomes evident. In such an enterprise, a new type of relationships between partners has to be set up. It is possible to symbolize it in the following manner.



To do so, the researcher needs to improve his knowledge of the internal coherence and diversity of the functionings of the APS in his area. At the same time, the role of the extension worker will be, more and more, to provide the different groups of farmers with adapted technical advice.

The preliminary diagnosis is the first step. It has to take into consideration facts which were largely put aside before, such as :

- The heterogeneities of both the natural and socio - economic environments.

- The whole complexity of the APS.

- The farmers' varied socio - economic objectives (food production for the family, level of cash income, living standard,....), as well as the differentiated strategies they select in order to achieve them.

The methodology of the diagnosis presented here is :

- systemic : it aims at understanding interactions between phenomena at various scales of levels of perception, from the plot to the region or even to the world market if necessary. The farm is here considered as a system finalised by farmer's objectives.

- dynamic : the knowledge of the evolution of the agro - ecological environment and the on going process of socio - economic differentiation is used to explain the present situation of the agrarian system.

- an interdisciplinary approach : this unables the generation of explanatory hypotheses at various levels of perception and the achievement of a common global understanding of a small regional agricultural situation.

The concept of agrarian systems and the theory of their evolution and differentiation (Mazoyer, 1978) have been used to build this methodology of diagnosis, and to organize observations, analysis and interpretation of real complex agrarian situations.

VARIABLES AND APPLICATION OF THE CONCEPT OF AGRARIAN SYSTEMS

The two steps of the theoretical work which has been used are :

1. The identification and characterization of the necessary and sufficient variables of the concept of agrarian systems : this includes the understanding of their interactions because, as shown in Figure 2, they cannot be analysed independently. The knowledge of these relationships between essential variables allows the identification of the existing conditions of a given type of agrarian systems. The fact that, beyond a certain stage of development, an agrarian systems cannot be understood without its relations to the other economic sectors of the social formation is noteworthy.

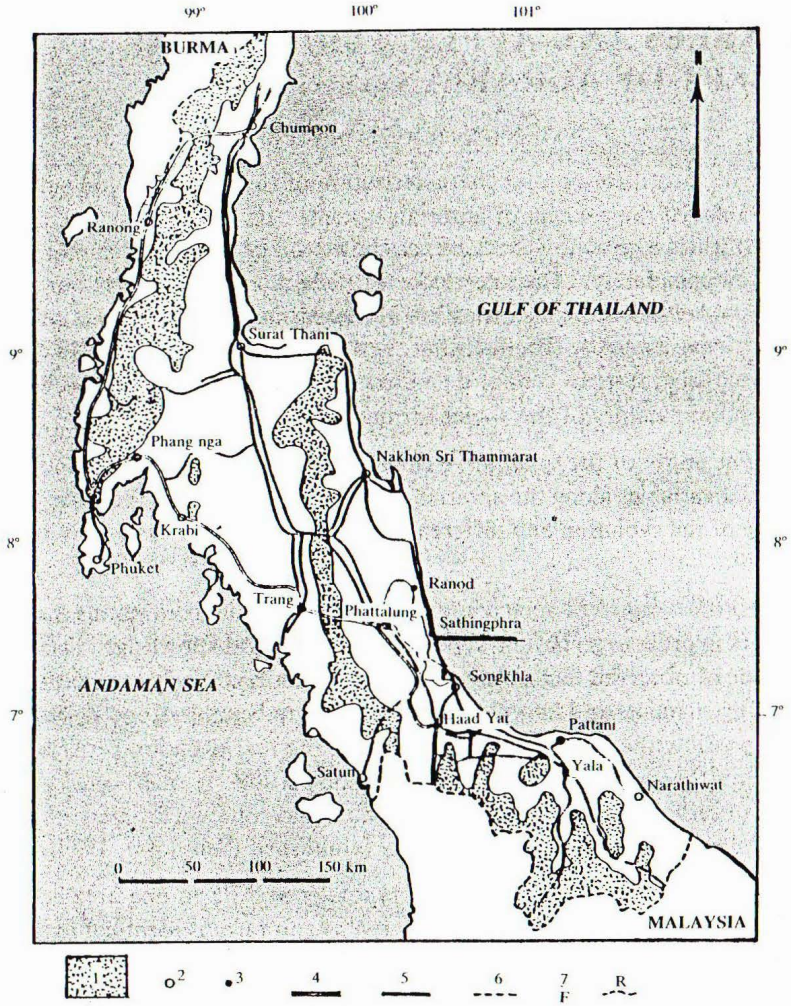
2. The study of the qualitative changes of these relationships among the essential variables along the agrarian history : while applying the concept, the theory of the evolution and differentiation of the agrarian systems is gradually built.

Scientific analysis of such complex situations implies continuous theoretical work in order to go beyond superficial and empirical knowledge. Facing a multitude of observed facts, only a theoretical model can help to select the determining elements and interactions which have to be understood in order to make possible the interpretation of most of the real situation observed. With such a theory in hand, the reality can be pertinently questioned and each key observation finds its place in a global and coherent framework in which explanatory relations are gradually established (Sebillotte, 1974).

For example, the proposition of a typology of APS in one area is an over simplification of an infinitely richer reality (no farm is identical to another one). But only the definition of such types, in a very limited number, can help to observe, understand and measure the extent of the process of socio - economic differentiation among the farmers in this area.

The main steps of the methodology of diagnosis on agrarian systems, which has been tested during the 1982 - 83 crop year in Sathing phra district-Southern Thailand (Map 1), are shown in Figure 3. Three essential levels of perception of the phenomena are used to organize the recorded information, they are:

- the agrarian systems : this is the synthetic regional level. Its boundaries are defined by its functioning logic, according to the importance of its relationships with macro - levels. Geographically, it is preferably a small regional area (from one tambon to one changwat) which displays a certain ho-



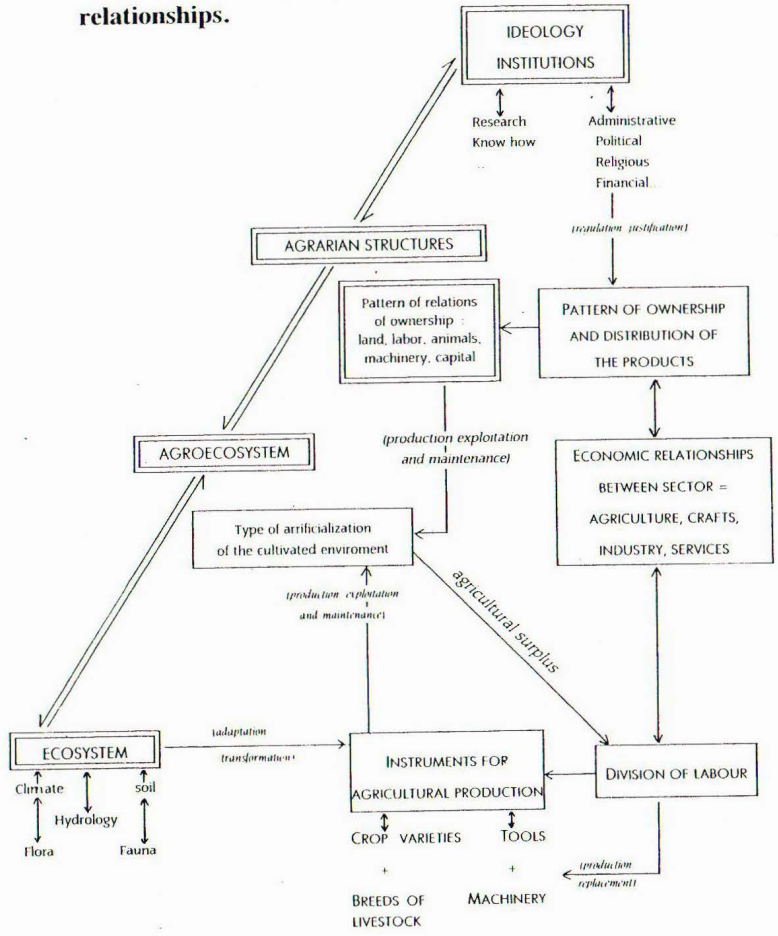
1 - UPLAND, MAINLY FORESTED
2 - PROVINCIAL CAPITAL
3 - DISTRICT HEADQUARTERS
4 - NATIONAL HIGHWAY
5 - PROVINCIAL ROAD
6 - RAILWAY
7 - FERRY
8 - INTERNATIONAL FRONTIER

MAP 1 : POSITION OF THE SATHING PHRA PENINSULA IN SOUTHERN THAILAND

mogeneity in the organization of its landscapes, and hence in its relations between the agroecosystem and the socio - economic environment. The study of its present takes into consideration the main recent transformations which have stood out as landmarks in the local agrarian history.

- the APS : here the scale is the household. The basic hypothesis made is that the necessary adaptation of farmers' existing practices to the heterogeneities of the natural environment and the evolution of the socio - economic conditions has led to a more or less important diversity of types of APS having differentiated socio - economic objectives and global strategies to achieve them.

Figure 2. The concept of agrarian system : the four variables and their relationships.



Source : adapted from MAZOYER, 1978.

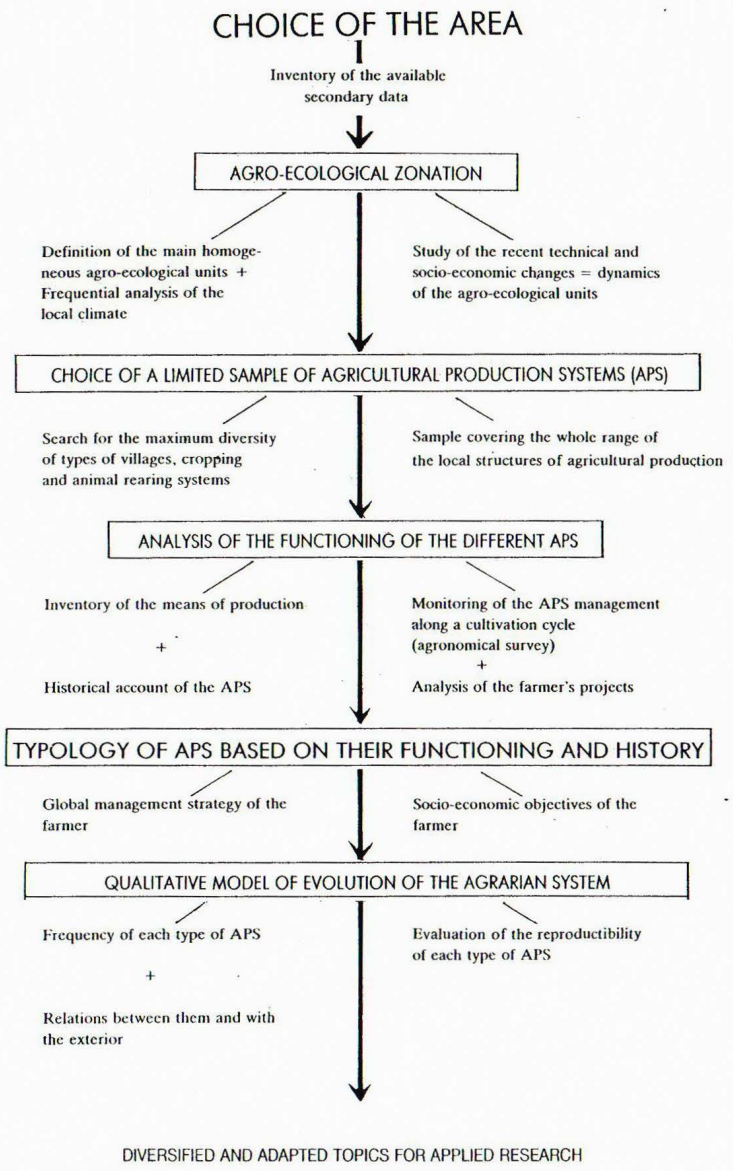


Figure 3. The successive steps of the diagnosis on agrarian systems and outputs at each step of the process.

- the cropping or animal rearing systems[1] : at the plot or herd levels farmers' technical choices are considered as compromises between potentialities and constraints of the bio - physical environment and the relative scarcity of certain economic factors of production. Based on this knowledge, new adapted itineraries of techniques[2] can be imagined and tested in order to remove the previously graded limiting factors. In other cases, the systemic approach allows to solve the problem through modifications elsewhere in the functioning of the APS.

Even though in practice many overlaps may occur when carrying out such a diagnosis, each step of the methodology is now discussed and illustrated below.

CHARACTERISTICS AND DYNAMICS OF THE MAIN AGRO - ECOLOGICAL UNITS

This first step begins with the realization of an agro - ecological zonation of the selected area, and is followed by a historical analysis of the recent technical and socio - economic transformations of the local agrarian system.

1. The regional agro - ecological zonation

The objective of this zonation is twofold :

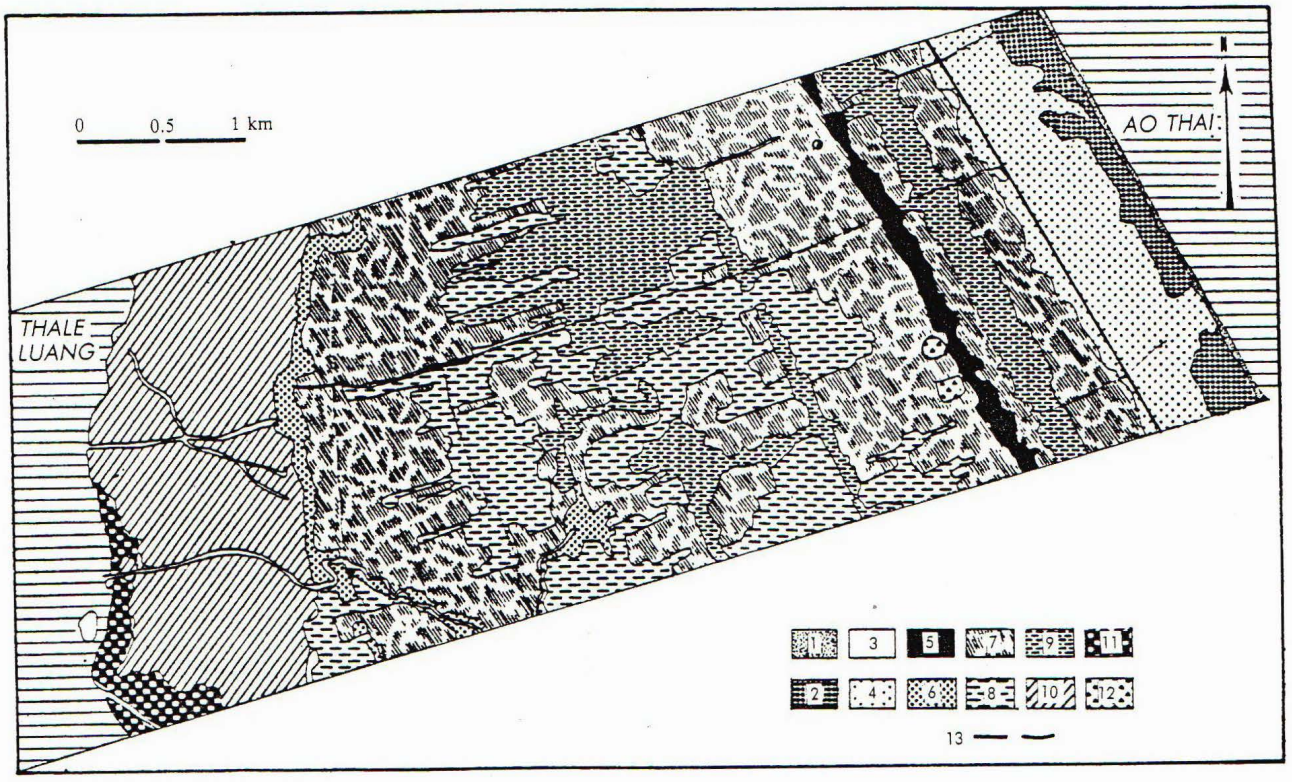
- To identify the dominant heterogeneities of the landscape and characterize several main agro - ecological units. The homogeneity of each unit is defined by the similar conditions of its climate - soil plant/crop complex.

- To single out the variables of the ecosystem which, in interaction with socio - economic factors, are fundamental in order to explain the regional distribution of the cropping and animal rearing systems.

The description of these agro - ecological units is based on the existing documentation about the area (topographical and soil maps, aerial and satellites imageries, climatological records over a long period of time, demogra-

1. CROPPING SYSTEM = the succession of crops and techniques performed on a plot of land. It expresses the farmer's choice of plant population combinations to reach his objectives in a given natural and socio - economic environment.

2. ITINERARY OF TECHNIQUES = a logical and well - ordered combination of the techniques applied to a crop by the farmer to achieve his objectives (SEBILLOTTE, 1978).



Map 2. : Agro-ecological units along an East-West transect from Ban Bo Daeng to Ban Tha Hin in Sathing Phra district.

UNIT NUMBER	DESCRIPTION OF THE UNIT	MORPHOPEDOLOGY	WATER DRAINAGE	VEGETATION (SOIL COVER)	DEGREE OF ARTIFICIALIZATION OF THE ECOSYSTEM
1	Sand dunes on present existing coast	Pure sand	Very rapid	Bare soil (none)	None
2	Uninhabited coastland =	Sandy regosols	Very rapid	Coconut palm, Casuarina, Spinifex, Ipomea (low)	Very low
3	Sacred woods with large Diptarocarps	Sandy regosols with humus	Very rapid	Diptarocarps (high)	Low
4	Type A villages on old sand ridges with many gardens =	Ash-coloured podzolized sandy regosols	Very rapid	Cashew nut tree, coconut palm, Disterocarps, Bambusa, Pandanus, many fruit trees and market garden crops (high)	Very high
5	Type B villages on old narrow sand ridges, with few gardens =	As above	As above	As above but less market garden crops	As above
6	Type C villages beside the lagoon =	Hydromorphic clay	Very low, flood prone	Tamarind, Leucaena, Bambusa (low)	High
7	Palmyra palm groves closely associated with rice =	Hydromorphic clay	Low	Oryza, Borassus fl. (high)	Very high
8	Palmyra palm groves loosely associated with rice =	As above	As above	As above	High
9	Rice fields without Palmyra palm =	Moderately to very strongly Hydromorphic clay	Very low, flooded part of year in the old drainage channels	Oryza sative (high)	Medium to Low
10	Grassland beside the lagoon =	Clay	Flood prone	Paspalum scrobiculatum (high)	Very Low
11	Mangrove swamps =	Permanently saturated clay	Permanently flooded	Sonneratia, Rhizophora, Acrostichum (high)	None
12	Freshwater ponds				
13	Dirt roads, all weather highway				

phic and agricultural statistics,...) and runs of several carefully selected line transects which cross the whole range of heterogeneities of the area. Each unit is characterized by a degree of artificialization of the ecosystem which reflects its potentialities and constraints to agricultural production, according to the instruments of production available at that moment. The result of such a work carried out South of Sathing Phra district is shown on Map 2. The information recorded during the field runs showed that the microtopography, and the related soil - water interaction, were the essential criteria to take into account when describing the distribution of the cropping and animal raising systems, or explaining the logic of many farmers' existing practices (Trebuil **et al.**, 1983).

With such mapping in hand, different types of villages can be defined, according to the combination of the agro - ecological units on their territories and the kind of socio - economic infrastructure available (roads,....). Thus in Sathing Phra area, three types of villages have been inventoried:

- Type I village = combination of lower flood - prone paddies with medium and higher paddies associated with sugar palms **(Borassus flabellifer).** Gardens on sand - bars, close to the sea and along the highway.

- Type II village = same association of paddyfields but fewer gardens (narrow sand bars, hillocks) and no main highway passing through.

- Type III village = medium to higher paddies associated with sugar palms close to swampy grassland beside the lagoon.

A more extensive, but also far more expensive, zonation of the same area has been carried out in 1986 - 87 using the Spot satellite numeric data (Bruneau **et al.**, 1988). Such agro - ecological mapping is very useful again when extrapolating the possible use of a promising itinerary of techniques adapted to the functioning of a specific type of APS in the area.

The principle of zonation can also be successfully applied to the characterization of the local climate. The frequential analysis which is proposed aims at delimiting the cropping seasons (using a comparison between rainfall and potential evapotranspiration). Their interannual variability, an important factor to consider when evaluating farmers' practices, can also be displayed on a graph (Figure 4).

At the end of this step, the main regional cropping patterns can be located in their specific bio - physical environments (Figure 5). But beyond this static analysis of the spatial distribution of the present agricultural production, only the historical account of the creation and evolution of these

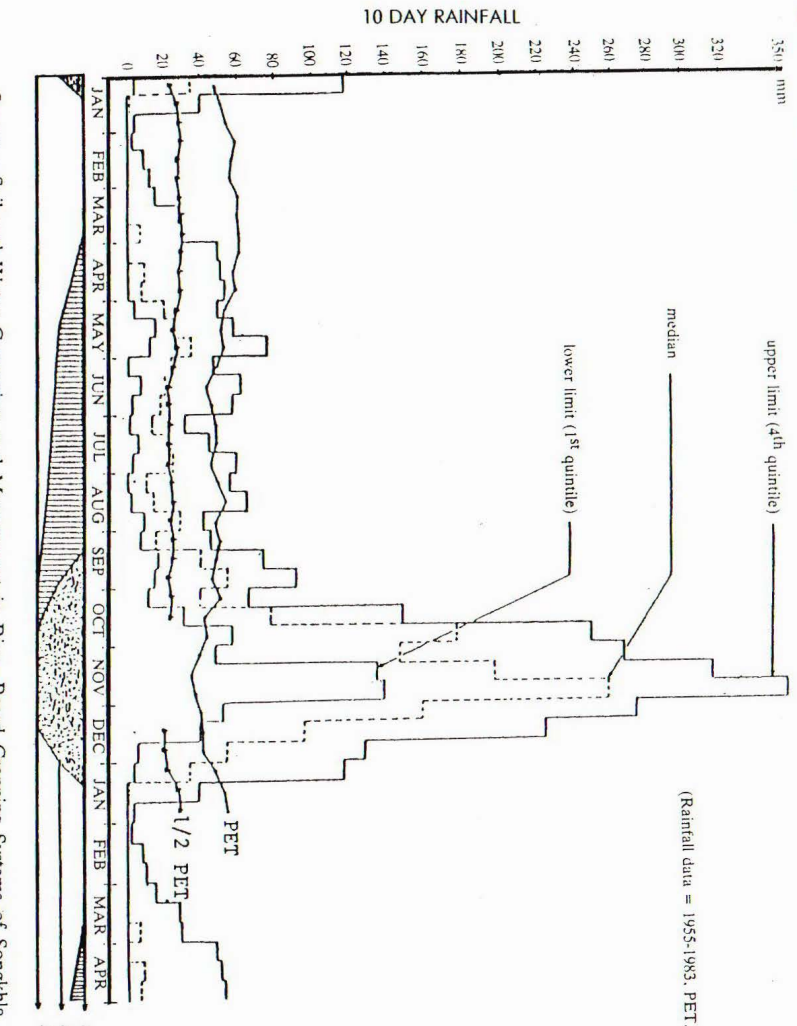
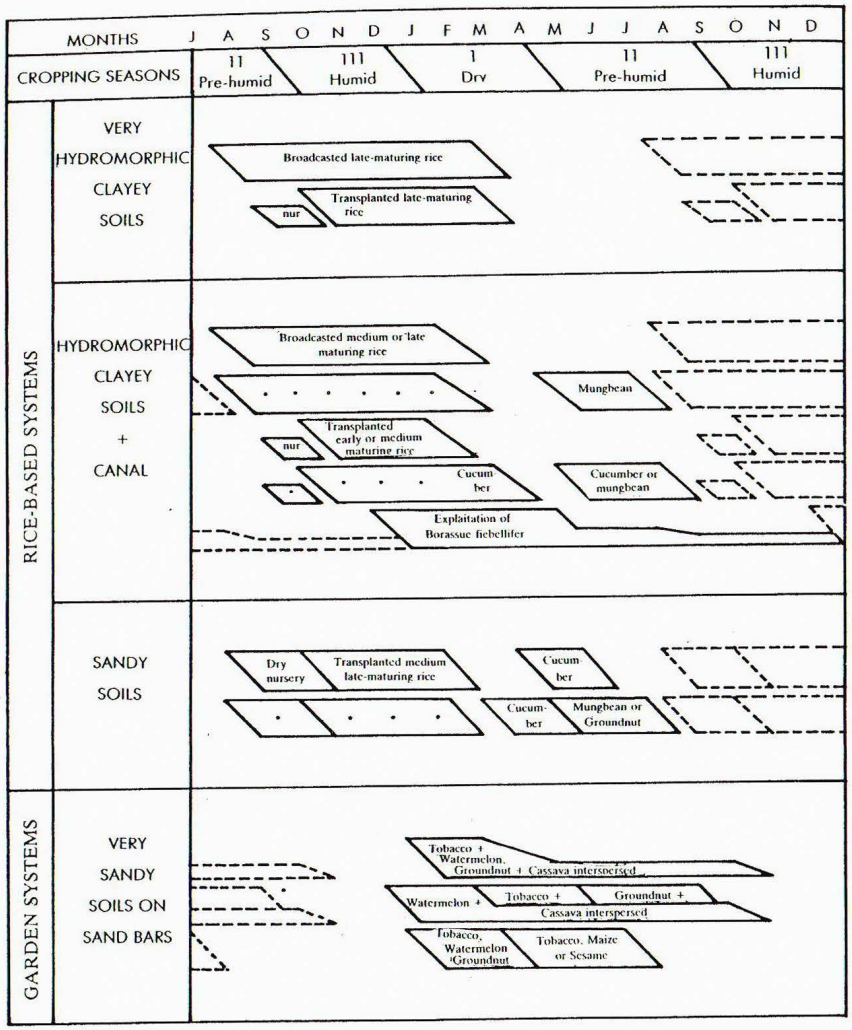


Figure 4. Delimitation and variability of the cropping seasons in Sathing Phra, Southern Thailand.

Source : Soil and Water Constraints and Management in Rice - Based Cropping Systems of Songkhla Lake Basin - Sathing Phra, Southern Thailand by CROZAT, Y. **et al.**, 1985.

Figure 5. Main cropping patterns in Sathing Phra Area - Southern Thailand.



agro - ecological units allows the identification of the origin of possible lack of agro - ecological balance. At the same time, the process of socio - economic differentiation among the local peasantry can be analysed.

2. Historical account of the recent technical and socio - economic transformations of the agrarian system.

This work is based on informal interviews with old people (farmers, officials, monks,....) in order to determine the main recent changes which have modified the organization of agricultural production. Particularly, the study focuses on the evolution of the dialectical relationships between farmers' practices (the mode of artificialization of the ecosystem) and the state and maintenance of local natural resources. As new techniques become available, the role of certain bio - physical factors in the distribution of agricultural production is changing. For example, in Sathing Phra area, the possibility to rent four - wheel tractors since the early 70's has allowed the farmers to grow rice, every year, over all the alluvial plain, including in very clayey and early submerged agro - ecological unit 9. On the other hand, the effects of the adoption of these new itineraries of techniques by the farmers on the maintenance of the agro - ecological environment have to be evaluated. Thus, Sathing Phra farmers declare that the mechanization of land preparation for rice and the related decrease of cattle rearing tend to favour weed infestation in paddies. But, even when such kind of information is very plausible, it should be used to generate hypotheses only.

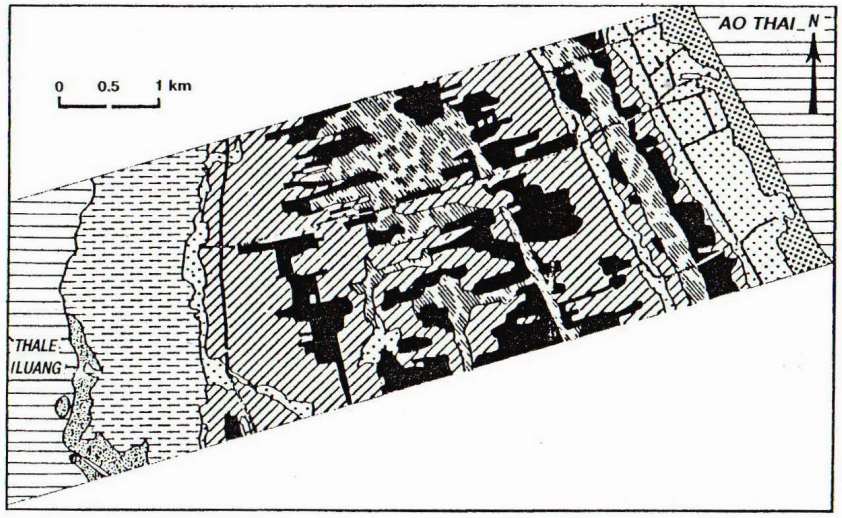
The pertinent information can be summarized in a simple way by pre paring an historical profile such as the one proposed in Figure 6. Technical facts (date, origin, cause of the introduction or disappearance of a new crop, domestic animal or cultural practice) are matched with socio - economic changes in the farms environment (demographic pressure, new infrastructure and services, access to new markets,...).

When possible, the information provided by selected informants has to be checked. For example, the use of chronological series of aerial imagery permits mapping of the dynamics of the main artificialized agroecological units (Map 3). A more detailed historical account of the Sathing Phra agrarian system has been published elsewhere (Trebuil **et al.**, 1983 ; Trebuil, 1984). Here, we just want to underline the originality of the modalities of the opening of this area to the market economy. When it is compared to the transformations of agriculture during the post second world war era, at both national and southern regional levels, this evolution seems to be twice marginal. Firstly, the expansion of the cultivated area has been quickly and na-

Figure 6 : Historical profile of the recent agrarian changes in Sathing Phra area.

TRANSFORMATIONS OF THE TECHNICAL CROPPING AND ANIMAL REARING SYSTEMS	SOCIO-ECONOMIC CHANGES IN THE ENVIRONMENT OF THE FARMS
• End of the reclamation of the swampy areas for paddy production, already associated with palm sugar production. • Sugar is scarce : palm sugar production increases.	1940
1950	
• Chemical fertilization of paddy is introduced in the district.	• First dirt road is built on Sathing Phra peninsula.
	1960 (300 inhabitants/km^2)
• Swamp buffalo rearing is decreasing. • Rice - Borassus flabellifer association is quickly expanding in the alluvial plain.	
1970	• Rental of 4 wheel tractors for land preparation for rice is introduced (50% of the farmers use them in 1982).
• First 2-wheel hand-tractors are introduced (5% of the farmers had one in 1982). • Garden production for the market is expending on the sand bars. • Hybrid rice varieties are proposed to farmers (less than 10% of the rice area in 1982-83).	• The highway linking S.P. to Songkhla is completed. • A network of tambon extension officers is operational.
	1980 (400 inhabitants/km^2)
• Intensive duck and chicken raising with relations with a feedmill and middlemen is more and more common. • Introduction of mungbean and cucumber crops rotated with rice. • Very few farmers apply insecticides on rice. More common on vegetables. • Imports of firewood (mainly rubber) for sugar production is expanding (annual production of some 10,000t mainly exported to Malaysia).	• More off-farm non-agricultural activities are available (shrimp deshelling,...). • "Arthit canal" is dug. • Ko Yo bridges are open to traffic, linking S.P. peninsula to Haad Yai - Songkhla urban and industrialising areas. A "Songkhla Lake Planning Study" is carried out (salinity barrier on the lagoon, irrigation on the peninsula).
1985	
• A wood and time-saving two-pan stove for palm sugar production is introduced.	

Source = surveys by the author.



1 - UNINHABITED COAST (1974)
2 - GARDEN-VILLAGES (1974)
3 - RICE-FIELD CO-PLANTED WITH PALMYRA PALM IN 1966
4 - RICE-FIELDS WITHOUT PALMYRA PALM IN 1966 OR 1974
5 - RICE-FIELDS WITHOUT PALMYRA PALM IN 1966, WITH IN 1974
6 - MARSHES ALONGSIDE THE LAGOON (1974)
7 - SWAMP WOODLAND ALONGSIDE THE LAGOON (1974)
8 - ROADS (1974)

MAP 3: CHANGES IN EXTENT OF PALMYRA PALM IN THE RICE-FIELDS FROM 1966 TO 1974 ALONG THE EAST-WEST TRANSECT FROM BAN BO DAENG TO BAN THA HIN-SATHING PHRA DISTRICT

(From aerial photographs taken in 1966 and 1974, scale 1 : 50,000).

turally limited, and up to now no irrigation scheme has allowed the practice of a second rice crop during the dry season. Secondly in the Southern region

as a whole, Sathing Phra is the only district in which rubber is totally absent, because of a very constraining soil/water interaction. Classified as a poor district by the National Economic and Social Development Board, this area has been isolated from the dominant transformations and regional specializations which have occured in the country during the last three decades.

Now that it is placed in its spatial (agro - ecological zonation and relationships with the national environment) and historical contexts, the analysis of the process of differentiation among the local APS can be carried out.

HOW TO WORK OUT A TYPOLOGY OF THE APS BASED ON THE ANALYSIS OF THEIR FUNCTIONING AND HISTORY

The above - mentioned recent technical and socio - economic changes led to a differentiation among the APS. The extent of the process is best evaluated by working out a typology of the farmers based on their economic objectives and global strategies to achieve them. To do so, according to the natural and socio - economic resources available, a good knowledge of the logic of farmers technical choices (both their strategical and tactical decision making processes) is needed. The basic hypothesis which is made here is that problems to be solved at the household level will differ according to the type of APS we are dealing with. It is clear that, this research work is strongly development oriented.

1. The choice of a limited sample of APS to be analysed.

A basic principle when building this sample is to search for the maximum diversity of cropping or animal raising systems to be included in it. This is usually not possible with the existing formal information. For such a purpose, secondary transects can be used. They are usually perpendicular to the primary transect which crosses the bio - physical heterogeneity of the milieu. Inside a single agro - ecological unit, the secondary transect is used to inventory the various itineraries of techniques, cropping and animal raising systems performed by the farmers. Then, in the same agro - ecological unit, we make the assumption that a significant difference in farmers' practices reveals differrent types of functioning of their APS. These inventories of farmers' practices have to be carried out in the main artificialized units. Then the

sample of APS is built in order to comprise all this diversity of existing techniques, without any concern about statistical representativity of the selected group of farms.

At the same time, the secondary data describing the local characteristics of farm structures, which are provided by the most recent agricultural census available, allows us to verify that the selected limited sample covers the whole range of variability of these agrarian structures. For example, the constitution of the sample of 10 APS surveyed in Sathing Phra district in 1982 - 83 is presented in Table 1

2. How to analyse the functioning of the selected APS.

The goal of the analysis of the functioning of the APS is to group them into a limited number of types having similar socio - economic objectives. We call this classification a functioning typology because it is based on an understanding of the logic of the farmers' management of their productive resources. To work out such typology, the following steps could be followed:

2.1 Inventory of the means of production and historical account of the APS.

The whole set of productive resources available on the farm is described during an informal interview and a tirst tour of all the farmers' plots which can be located on a farm map, in their respective agro - ecological units. When recording the history of the APS, the principal technical changes identified are related to important strategical decisions made by the farmer (sell cattle and buy a hand - tractor, rent a four - wheel tractor to till the paddies and continue to tap the sugar palms during the pre - humid season in order to increase cash income,...). This dynamic approach of the APS is completed by a discussion about the farmer's projects for the near future. At the end, a first picture of the global evolution of the farm situation can be worked out (accumulation of means of production or only maintenance of the same level of productive resources, degradation of the productive potential, etc.).

2.2 Monitoring of the management of the APS along a complete cultivation cycle.

In order to monitor the farmers' management of their APS, all the plots are visited with the producer at key periods of the main crop cycle. Thus, in Sathing Phra area, six visits took place during the rice growing season, from July 1982 to March 1983. So, direct observation of farmers' practices and their effects on the crop population was carried out at land preparation and direct broadcasting, transplanting, weeding, water control before and

during heading stage, and twice at harvest time which is very staggered here (tens of varieties are grown, with cycle of very different length, from 4 to 7 months; farmers harvest panicle by panicle with the small traditional knife or "kae"). The data recorded during these visits allowed the plot per plot, assessment of soil and labor productivities according to the various itineraries of techniques performed by the producers. At this stage, the discussions with the farmers aim at understanding their tactical decisions when they have to make technical choices.[1] For such a purpose, the articulation of all the farm activities for the use of the limited productive resources has to be taken into consideration including the financial management of the APS. It has been demonstrated that the repetition of such visits improved the quality of the recorded data. Direct observation of the phenomena with the farmer allows the researcher to compare farmers plans with his real practice and helps to reach, gradually, a good understanding of the APS internal coherence. The strategy chosen by the farmer in order to achieve his objectives is identified whereas the constraints and bottlenecks which hamper their realization can be graded.

2.3 Analysis of the data recorded during the inventory survey and the monitoring of the APS management.

Analysis of the recorded data is also a gradual process taking place after each visit to the farmers. At each key level the objectives are as follows:

- cropping system level : to understand the logic of farmer's choice of itineraries of techniques, especially their degree of adaptation to the local conditions of production and the variability of their performances in different bio - physical environments.

- APS as a whole : to identify farmers' economic objectives and global strategy to realize them; to grade the constraints which impede a better functioning of the APS towards such objectives.

- Agrarian systems level : to explain and measure the extent of the process of socio - economic differentiation among the producers; to characterize simply each main type of APS and evaluate the size of each group of farms having similar objectives and global strategy; to understand their interrelations as well as their links with the other non - agricultural sectors of the social formation.

1. It is at this stage that several crop situations are selected for the agronomical survey. In these plots, the effects of farmers' practices on growth and development of the crop are evaluated. See Yves CROZAT's article below.

Table 1 : Selected criteria used to build the sample of 10 APS studied in Sathing Phra district in 1982-83.

FARMER	TYPE OF VILLAGE AND	FARM STRUCTURES			CROPPING AND ANIMAL REARING SYSTEMS PRACTISED
NUMBER=	AGRO-ECOLOGICAL UNITS (AEU)	Age	Membe	Surface (ha)	
1	Village = type I	30	3	0.9	RICE (broadcasted) – DUCKS
2	A.E.U. = 1, 2, 3	58	5	1.4	RICE (broadcasted) – PALM SUGAR (all the year round) – DUCKS – OFF-FARM ACTIVITIES
3	4 7, 8 9	61	7	4.8	RICE (broadcasted) – GARDENS – CATTLE – FISHING
4		60	4	5.4	RICE (broadcasted, hand-tractor) – GARDENS – CATTLE
5	Village = type II A.E.U. = 5 7, 8 9	46 47	8 5	1.8 3.6	RICE (broadcasted, hand-tractor) – PALM SUGAR – CATTLE OFF-FARM ACTIVITIES RICE (broadcasted + transplanted, hand-tractor + pump, hybrid variety) – GARDENS – OFF-SEASON CROP BETWEEN RICE – CATTLE
7	Village = type III	40	8	1.0	RICE (transplanted, hybrid var.) – PALM SUGAR – FISHING – OFF-FARM ACTIVITY
8	A.E.U. = 6 = 7, 8 10 11	46	4	2.5	RICE (broadcasted + transplanted) – CATTLE + SWINE + DOVES + FISHING
9		45	8	4.4	RICE (broadcasted + transplanted, hand-tractor, hybrid varieties) – MUNGBEAN – SWINE
10		61	6	7.5	RICE (broadcasted + transplanted, hand-tractor) – RICE MILL – SWINE – WAGE LABOR – OFF-FARM ACTIVITIES

Table 2 : The diversity of cultural practices in rice among ten farmers in Sathing Phra district (1982-83 crop year, 158 plots surveyed).

CULTURAL PRACTICE	VARIETAL CHOICE (number of varieties)	CROP IMPLANTATION*	WEEDING (days/ha)	FERTILIZER (kg 16-20-0/ha)
AEU 4 and 5 = higher paddies on coastal sand ridges.	3	1, 3, 4	0 to 80	0 to 200
AEU 9 = deep water rice paddies on very clayey soils.	7	1, 3	0 to 125	100 to 500
AEU 7 and 8 = medium to higher paddies on very clayey to sandy – clayey soils.	19	1, 2, 3, 4	0 to 190	0 to 415

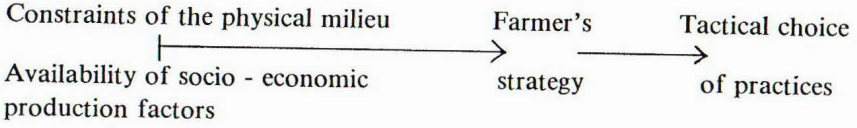
1 = direct dry – seeded broadcasting *2 = broadcasting of pre – germinated seeds on muddy soil.*
3 = (nursery – pulling) – transplanting *4 = only partially pulled nursery.*

At each of these three levels, agronomic data are matched with information of a socio - economic nature : the technical facts observed are related to the interests of each of the social groups of farmers identified.

3. A case study : the adaptation of farmers'practices to various biophysical environments in Sathing Phra paddyfields.

When monitoring the 10 selected APS in 3 villages of Sathing Phra area, a very large number of itineraries of techniques performed by the farmers has been found (Table 2).

As this high variability of farmers' practices is mainly due to a blow by blow type of decision making because of the lack of efficient water control, it is easy to understand that in such situation the adoption by the producers of the single standard itinerary of techniques which is proposed by the extension service quickly reaches its limits. But new, more adapted, ways to improve the local rainfed rice crop could be identified by studying the logic of the existing farmers' itineraries of techniques. For such a purpose, both the constraints of the physical environment and the farmers' access to various production factors have to be taken into consideration :



Two examples are given below.

Table 3 : Rationality of Sathing Phra farmers during the implantation of their rainfed rice crop.

PHYSICAL ENVIRONMENTAL CONSTRAINTS	POSSIBLE SOCIO-ECONOMIC LIMITING FACTORS	FARMERS' STRATEGY	CULTURAL PRACTICES PERFORMED
• Uncertain date of flooding of the plots between August and October. • Very clayey soils = number of days for land preparation and sowing are limited (succession of dry periods with temporary flooding during the pre-humid season).	• Equipment for land preparation on APS of type A. • Mobility of the labor involved in other economic activities.	Risk avoidance = to insure, every year, the implantation of the rice crop on all the plots at minimal costs in order to satisfy family needs.	Early dense, and staggered direct dry–seeded broadcastings of late maturing local rice varieties, adapted to water stress, high weed infestation and low availability of nutrients.
• Very clayey soils and sudden submersion in lower paddies (few weeds).	• Power for tillering on non-machanized farms. • Cash availability to rent a tractor.		Very early direct dry-seeded broad-casting of very late maturing deep water rice varieties after one single ploughing.
• Poor emergence if fine seedbed structure. • High weed infestation.	• Cash availability or availability of equipment for land preparation for rent. • Plot-village distance.	To avoid peaks of work in paddy fields.	Production of small clods by two spaced (several weeks) ploughings.
• Delayed emergence in dry years. • Poor availability of N, P.	• Cash availability.	To try to optimize the use of a costly input available in limited quantity.	Post emergence application of chemical fertilizer.
• High water stress on sandy and sandy-clayey plots. • Very high weed infestation.	• Availability of well located plots (higher paddies, close to the road).	Risk avoidance = availability of seedlings for transplanting in difficult conditions.	Ploughed in broadcasting of dry nurseries, later totally or partially pulled (depending on weed infestation).
• Lack of efficient water control on most of the plots. • Distribution of the rainfall in October-November: limited number of days for transplanting in good conditions.	• Ibid. • Availability of equipment for quick puddling. • Availability of the labor according to other economic activities. • Wage-labor availability or cash availability to pay workers.	To maximise rice production for the market through high yields on a limited number of less risky plots.	Sowing on mud of pre-germinated seeds in nurseries. Seedlings of recommended HYV pulled 25 to 30 days later. Densely transplanted recommended varieties, fertilized twice and with chemical control of insects.
• Not enough or too much water in the plot. • Natural hybridization of wild rice with local varieties.	• Availability of family or wage workers because or other more profitable opportunities. • Cash availability.	• Full employment of the family labor (very low opportunity cost in November in agriculture).	Thinning/transplanting of the dry-seeded broadcasted plots during the tedious, late, and always incomplete hand weeding.

3.1. The logic of Sathing Phra farmer's practices for rice implantation.

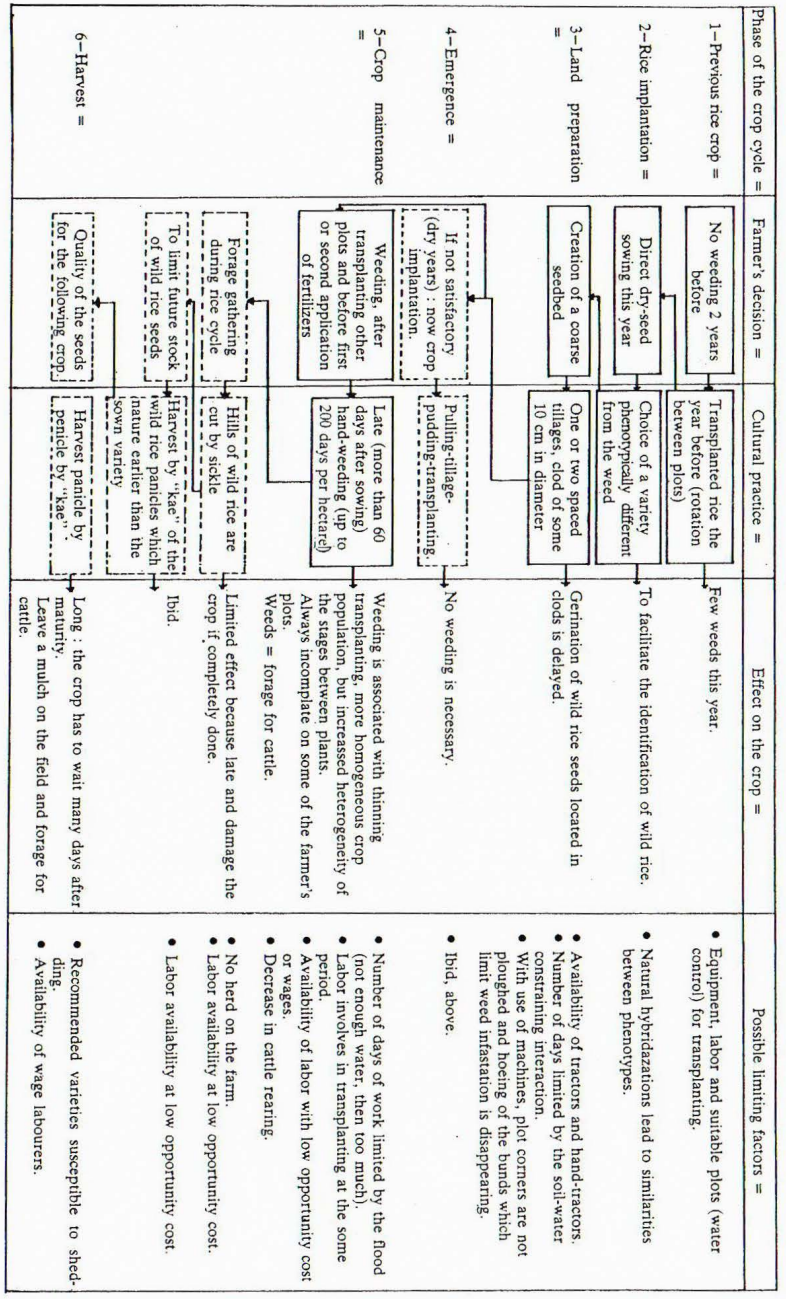
In a physical environment characterized by a very constraining soil-water interaction, rice implantation is traditionally carried out from July to November. The logic of farmers' technical decisions is shown in Table 3. It is clear that the limited availability of certain production factors according to the type of farm we are dealing with is an important source of variation of the observed itineraries of techniques. Added to the constraints of the natural environment, the scarcity of specific production factors is an essential consideration in attempting to explain farmers' strategies and tactical technical choices. The difficulties encountered by the farmers in carrying out their practices in the best possible conditions can also be fully understood.

For example, the data provided in Table 3 show clearly that the adoption by the farmers of the itinerary of techniques proposed by the extension service (transplanting of RD 5 or 7 varieties at 25 days, two applications of 16-20-0 and urea fertilizers, chemical control of stem borer, good control of the water level, harvest by sickle and threshing in the field) is only carried out on a limited number of well - drained plots. To be adopted, it has also to fit with the farm equipment (mechanization of land preparation) and the objectives of the farmers, that is to say, to maximise both labor and soil productivities on these plots (their respective recorded levels were 47 kg of paddy/day of labor and 3.8t/ha, in comparison with the mean paddy yield of 1.9t/ha observed that year in the district).

3.2. Rationality of farmers' practices to control wild rice **(Oryza perennis) :**

The farmers' strategy to limit wild rice infestation in their dry - seeded broadcasted paddies is shown in Figure 7 and has been presented in more detail elsewhere (Trebuil **et al.**, 1984). Already common in the uncultivated swampy areas several decades ago, wild rice is now the most dreaded weed. Farmers report an increase in the severity of its infestation in spite of the multiplication of the weed control practices carried out by the producers. With sometimes up to 200 days of labor per hectare for hand weeding, or no harvest at all because of a too high level of infestation of the plot, these farmers practices achieve very limited results while keeping labor productivity in broadcasted paddies at a very low level. The recent changes in the farms economic environment (particularly the growing availability of more profitable and less irksome job opportunities) and the related differentiation among the local APS have led to a situation where the number of farms with cattle herd and low opportunity cost of the labor during the rainy season is decreasing steadily. Now, even on such farms, the wearisome hand weeding of all the

Figure 7. Sathing Phra rice farmers' practices for wild rice control along the crop cycle.
(---------- = not very common practice)



plots cannot be completed every year. They are, more and more surrounded by other types of APS in which either non - rice activities are dominant or hand weeding of numerous plots is neglected. This is because an "extensive" strategy has been chosen on largest farms where wage labor is scarce, or a competition for labor is taking place if the farmer has decided to transplant his best located plots.

This example shows that a global understanding of the evolution of the cropping and agrarian systems is useful when searching for an adapted solution to a technical problem such as wild rice control. It is clear here that different itineraries of techniques have to be imagined, according to the varied farmers' management strategies and availability of productive resources, in order to propose adapted solutions to each group of APS which cohabit in this area.

4. Elaboration of a typology of APS based on their functioning and history.

During the analysis of the functioning of the various selected APS, the essential information is gradually summarized in diagrams which display the farm internal coherence. While doing these diagrams, APS having similar functionings, i.e. economic objectives and global strategy to achieve them, are grouped together in a limited number of types of farmers (Table 4). For each type of APS, its principle structural constraints to a better achievement of the farmer's objectives are underlined.

When it is possible, such qualitative classification of the APS can be translated into a more quantitative presentation of the typology (Table 5) to do that, a limited number of pertinent criteria have to be identified in order to describe each type of APS and display their differences. They cannot be selected a priori, but to be relevant they have to be chosen at the end of the analysis of the functioning of each main category of APS.

Among them, synthetic indicators can be used to measure the size of each group of farms (Figure 8). These indicators are also useful in the field in order to relate quickly any farm to one of the types of the typology. They can also be used to delimit socially the domain of extrapolation of a new promising itinerary of techniques for example.

The presentation of the functioning typology can be adapted in order to facilitate the transfer of the results of the diagnosis to the institutions in charge of agricultural development and planning (Table 6).

Table 4. The main types of functioning of the APS in Sathing Phra area

TYPE OF A.P.S. :	PRINCIPAL ECONOMIC OBJECTIVES :	GLOBAL STRATEGY CHOSEN BY THE FARMER =	MAIN CONSTRAINTS FACED TO IMPLEMENT IT :
A	- Production of enough paddy for family needs. - To maximise the daily income of the family labor force.	- Non-rice economic activities are dominant. - They are selected according to the local opportunities, in-order to maximise daily income on a short term basis. These activities vary if a small initial capital is available (duck or chicken raising) or not (palm sugar making, fishing, shrimpdeshelling, wage-earner,...).	- Access to land (loans on security if savings) and capital (dependence on village money lenders). - No equipment for land preparation. - Family labor involved in other jobs at key phases of rice cycle (transplanting, weeding, harvesting) - Lack of local firewood for palm sugar making and low quality of the final product.
B	- To maximise family income, through, full employment of the family labor in low risk activities - Relations with the market and productive investments, (purchase of land) are still limited.	- Traditional rice production occupies all the family labor in the humid season. Important storage of paddy is common. - Cattle hard is a form of "live-savings" and is managed by the elder man. - In between rice other activities (palm sugar production, gardens) do not necessitate cash investments.	- Access to land (number of "rai" per active person is still limiting) : rent in more land or loans on security. - Low labor productivity in rice and cattle rearing. - Reduced mobility of the family labor force (often aged) limits access to certain job opportunities.
C	- To maximise the gross margin per hectare and the family labor productivity in rice	- New rice technologies are adopted on the well-located plots. - A large part of the rice harvest is sold every year. - Cash crop production (mungbean, cucumber,...), in paddy field between two rice crops or in gardens	- Labor is scarce at certain phases of the rice cycle = transplanting (without good water control) harvesting (sickle and threshing in the field of recommended varieties sensitive to shedding).
D	- To maximise the profitability of the investment capital - Eventual cautious land accumulation	- "Extensive" rice production for the market with frequent recourse to hired labor. - Various investments in activities linked to agriculture (ricemill and associated swine production palm sugar marketing,...) or not (transportation, real estates,...). - Exchange of paddy fields against loans on security and purchases of vacant land.	- Hired labor availability because of new more profitable and less tedious job opportunities, and lack of water control which does not allow a staggering of cultural practices such as transplanting or weeding.

Source : Monitoring along a rice cultivation cycle of a selected, limited sample of farming systems in 1982-83.

Table 5, Differentiation among the APS in Sathing Phra area for several relevant characteristics.

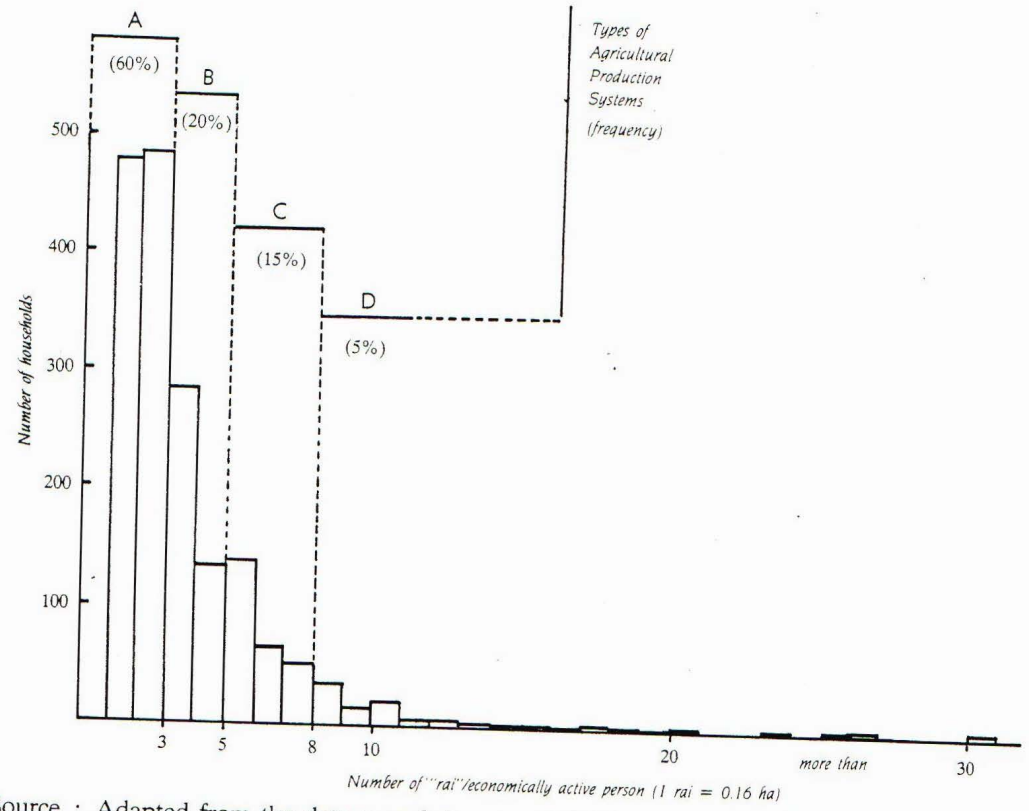
(Legend : - = none, + = not important, + + = important, + + + = very important)

TYPES OF AGRICULTURAL PRODUCTION SYSTEMS =	A	B	C	D
LABOR :				
1 – Number of hectares cultivated per economically active person in the household :	0 - 0.5	0.6 - 0.8	0.9 - 1.2	> 1.2
2 – % of hired labor in agricultural production :	3 - 15	0 - 1	1 - 5	16 - 34
3 – Global labor productivity in rice (kg paddy/day of work) :	19 - 24	13 - 15	22 - 30	20 - 26
LAND :				
4 – % of the cultivated area owned with formal land title (no so 3) :	0 - 65	80 - 100	100	100
CAPITAL :				
5 – Equipment for land preparation :	None (or oxen)	Oxen or hand-tractor	Hand-tractor	Hand-tractor, Oxen
6 – % investments + inputs in agriculture/family consumption + savings :	10 - 1000 ★	20 - 30	100 - 1000	40
RICE CROPPING SYSTEM :				
7 – % of the rice growing area planted with recommended varieties :	0	0 - 15	50 - 90	20 - 30
8 – Importance of hand weeding in broadcasted paddies :	+ +	+ + +	+	+
9 – % of the total rice harvest commercialized :	0	5 - (90) ★★	40 - 50	50
ANIMAL REARING SYSTEM :				
10 – Intensive chicken or duck raising :	–/ + + +	+	–	–
11 – Swine :	–	+	+ +	+ +
12 – Cattle :	–	+ +	+	+
PALM SUGAR PRODUCTION :	+ + +	+ +	+	+

★ *If intensive chicken or duck raising.* ★★ *Massive sales of stored paddy to pay for the purchase of a piece of land.*

Source : Monitoring of a sample of 10 APS in Sathing Phra district in 1982-83 crop year.

Figure 8. Frequency of the types of Agricultural Production Systems according to the land/ labour ratio.



Source : Adapted from the data recorded among 2029 households in 4 Tambon of Sathing Phra district by the agrcultural extension officer in 1982-83.

Table 6. Simplified presentation of the typology of APS in Sathing Phra area for the planning of development actions (same legend as Table 5.)

TYPES OF AGRICULTURAL PRODUCTION SYSTEMS :	A	B	C	D
IDENTIFICATION : Number of rai cultovaled per active person = R/A	3>R/A	5>R/A>3	8>R/A>5	50>R/A>8
IMPORTANCE OF RICE PRODUCTION :	+	+ + +	+ + +	+ +
– Equipment for land preparation :	none	Oxen/Hand tractor	Hand-tractor	Hand-tractor Oxen
– Transplanting of hybrid varieties :		+	+ + +	+ +
– Hand weeding in broadcasted paddies :	+ +	+ + +	+	+
IMPORTANCE OF PALM SUGAR PRUDUCTION	+ + +	+ +	+	–
% OF FARMS BELONGING TO EACH CATEGORY IN THE DISTRICT :	60	20	15	5

PROPOSITION OF A QUALITATIVE MODEL OF THE EVOLUTION OF THE AGRARIAN SYSTEMS :

The elaboration of such a model is based on the evaluation of the role of each type of APS in the local relations of production and exchange. The likely evolution of each category of APS is also forecasted.

1. Identification of the main relationships between different types of APS and their economic environment.

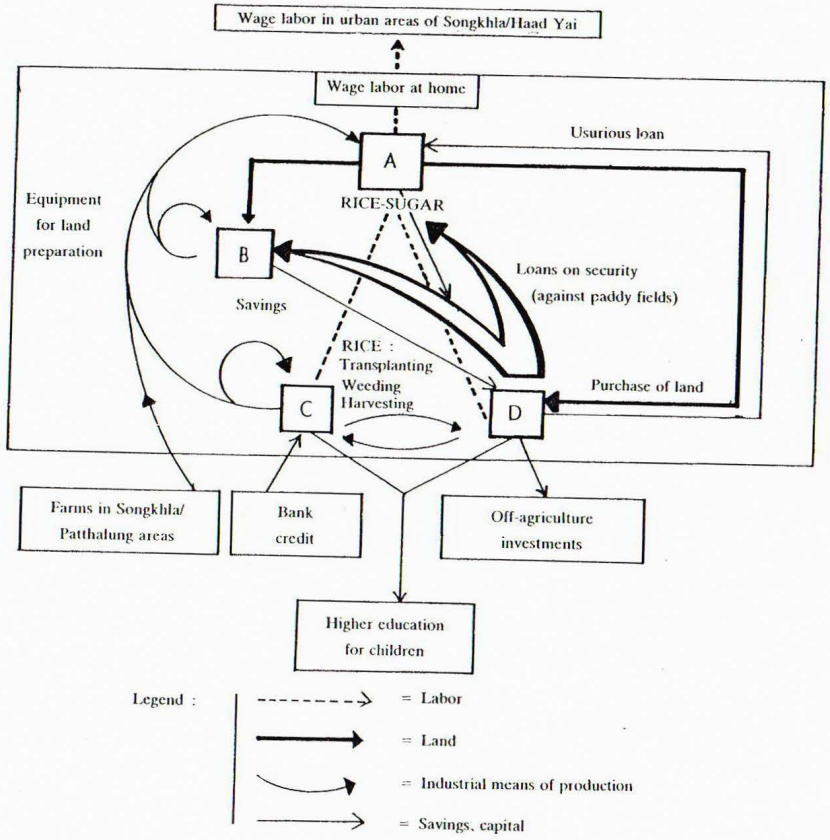
In the case of Sathing Phra area, these principal interactions between types of APS, which are essential for a good understanding of the functioning and evolution of the agrarian systems, are shown in Figure 9. In the diagram, the modes of circulation, concentration and dispossession of certain agricultural factors of production are displayed. The nature of the links between the categories of APS and their economic environment is also illustrated.

2. Analysis of the capacity of the different types of APS to maintain and continue to operate in the future.

Three tools are used to evaluate such capacity :

- The historical account of the APS.

Figure 9. Relevant interactions between types of APS and relations with the other economic sectors in Sathing Phra area.



Source : Survey by the author in Sathing Phra district, 1982-83 crop year

- The evaluation of the use and maintenance of the farm productive resources (soil fertility, financial results,.....) which is carried out after the monitoring of the management of the APS during an annual cycle.

- A judgement on the feasability of farmer's projects.

The theory on the evolution and differentiation of agrarian systems is then used in order to interpret the data. Particularly, the pertinence of the contradictory process of concentration - modernization for some farmers and crisis - elimination for the others is tested (Mazoyer, 1981). Theoretically, this process occurs continuously for a less important number of farms which are able to go beyond an accumulation threshold. As the level of this threshold is determined by the evolution of the labor productivity in the other sectors of the economy, it is increasing with the time.

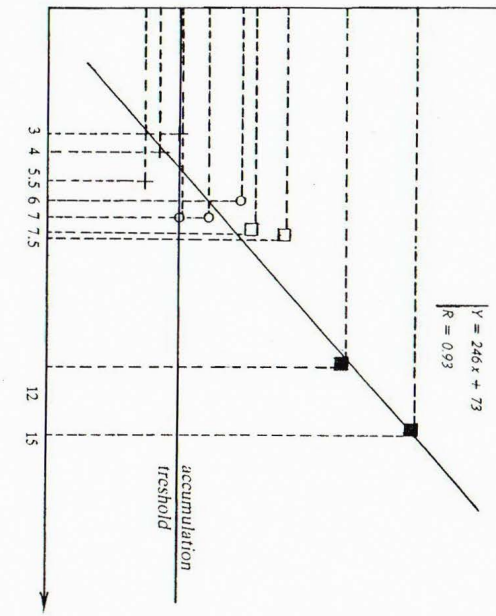
In Sathing Phra area, where the number of "rai" cultivated per economically active member of the household allows the differentiation of our types of APS, the level of the threshold in 1982 - 83 could be located somewhere around 1,25 tons of paddy per family worker (Figure 10). That is to say above the limit between APS types A and B

When analysing APS belonging to the type A, no accumulation of means of production can be detected. But it is clear that their elimination has been strongly restrained by the recent expansion of palm sugar production. The traditional organization of this activity guarantees the full employment of the family labor on the majority of the small farms which have historically been dispossessed of paddy land (Trebuil **et al.**, 1983). But in the absence, until these last years, of any improvement in the techniques of production of palm sugar, the labor productivity in this activity remains low. On the other hand, the recent multiplication of off - farm job opportunities attracts more the young labor force, which is often liberated to these new activities when the elders disappear and the APS has to be divided again.

Case studies show that this could also happen in APS of the B type, which then gives birth to two or more types A. If the land is not divided among the household members, there is a greater chance to join the type C category (in such situations, for example, sale of the cattle and purchase of a hand tractor is frequent). Type B is a transitory category of APS which can move on both sides of the accumulation threshold according to what happens during the next step of the family cycle.

Provided with enough means of production (land accumulation, mechanization,.....) as well as the support of institutions for technical assistance and agricultural credit, the APS belonging to the C and D types are

Figure 10. Labor productivity in rice as a function of the number of rai/family worker : situation of the different types of APS in Sathing Phra area in 1982-83.



Source : Monitoring of a selected sample of 10 farms during 1982-83 crop year.

specialized rice - based systems. As they are able to reach a higher level of labor productivity in rice (Table 5), the process of transformation of the local agriculture is leading towards such APS. But this evolution is still restrained by both the lack of an efficient system of water control in paddies (its realization would be very difficult because of the characteristics of the physical environment) and the vitality of the non - rice activities in the area which creates a lack of hired labor at key periods of the rice cycle.

With such a model in hand and the knowledge of the priorities defined in the national policy for social and economic development, topics for applied research in rural areas or extension (if an adapted solution to the problem is already available) can be selected. They will be adapted to the main local constraints identified and diversified because of the various types of APS found in the area. Thus, in Sathing Phra area, the improvement of palm sugar processing was a relevant topic for the less favoured A and B types of APS. It is also in agreement with the rural policy of poverty eradication, limitation of labor migration and promotion of cottage - industries. On the other hand, on - farm trials are conducted with farmers of types B, C and D in order to improve the methods of rice implantation and weed control in dry - seeded broadcasted paddies.[1]

CONCLUSION

In order to understand the technical and economic rationalities that command the functioning of the different kinds of APS in a small area, one has to look closely to the adaptation of existing farmers' practices to their local agro - ecological and socio - economic environments. The analysis of the recent evolution of these practices is also of considerable interest as has been shown in the case of Sathing Phra area.

With the elaboration of a qualitative model of evolution of the agrarian system, the diagnosis approach presented here reveals that the proposed topics for adapted applied research or extension activities represent social stakes. Thus, in the present case of Sathing Phra area, they promote the maintenance of the agroecosystem and the consolidation of the local agrarian structures by helping the less favoured APS to continue. They do not aim to increase soil productivity or to select a minority of already more efficient

1. For more details, see the other articles illustrated by the Sathing Phra case study in the second and third parts of this book.

producers. By improving and optimizing the local productive resources, in preference to the more common import of standard technologies, this approach contributes to the definition of a more sustainable way of agricultural development. The proposed topics are, for example, characterized by a lower level of dependance on the outside world and a better ability to create rural employment.

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REFERENCES

Dufumier, M., 1987. Farming Systems and Agricultural Development in Developing Countries. Proceedings of the 4th Thailand National Farming Systems Seminar, prince of Songkla University, Haad Yai, Thailand. 7-10 April 1987.

Mazoyer, M., 1978. Evolution et différentiation des systèmes agraires. Lectures given at the Paris - Grignon National Agronomical Institute.

Mazoyer, M., 1981. Origines et mécanismes de réproduction des inégalités régionales de développement agricole en Europe. Congress of the European Association of the Agricultural Economists, Belgrade, Yougoslavia, 31 August - 4 September 1981.

Sebillotte, M., 1974. Agronomie et Agriculture : essai d'analyse des tâches de l'agronome. Cahiers ORSTOM série Biologie, No.24, 3-25.

Sebillotte, M., 1978. Itinéraires techniques et évolution de la pensée agronomique. Compte - rendu de l' Académie d' Agriculture de France, 64, 906 - 914.

Trebuil, G., Thungwa, S., Patamadit - Trebuil, I., 1983. The Present System and Recent Changes in Land Use in Sathing Phra District, Southern Thailand. Research on Farming Systems Project, Faculty of Natural Resources, Prince of Songkla University, Publication No.2, 101 pp + appendixes.

Trebuil, G., 1984. A Functional Typology of Farming System in Sathing Phra Area, Southern Thailand. Communication at the International Conference on Thai Studies, Bangkok, Thailand 22 - 24 August 1984, 26 pp.

Trebuil, G., Crozat, Y., Thungwa, S., Chitapong, P., 1984. Weed Problems and Farmers' Weed Management Strategies in Rainfed Paddy Agroecosystems of Sathing Phra, Southern Thailand. Proceedings of the First Tropical Weed Science Conference, Haad Yai, Songkhla, Thailand. 22 - 25 October 1984, Vol.1, 66 - 87.